Collecting Indigenous Forest Tree Seed in Zambia

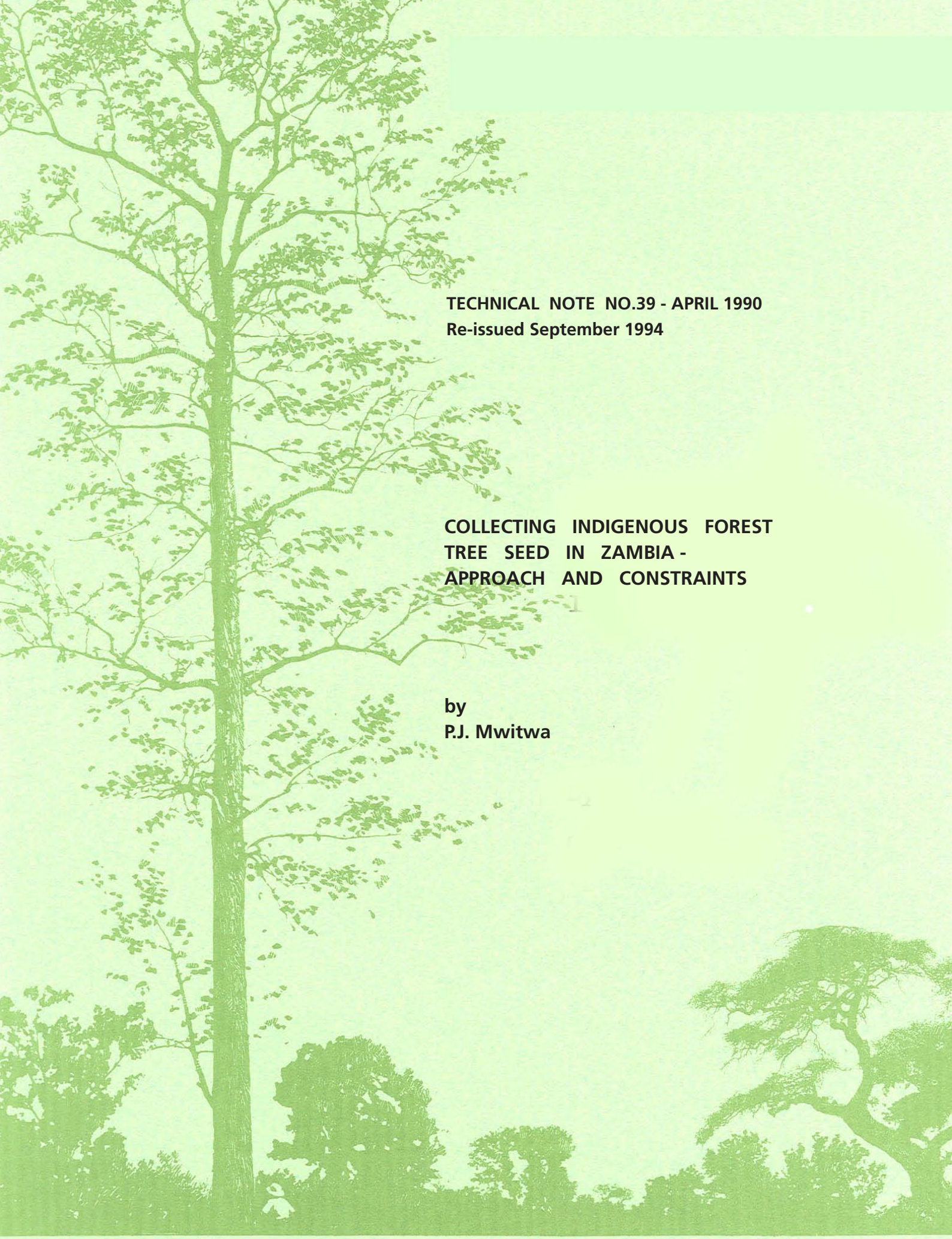
Approach and Constraints

Mwitwa, P.J.

Publication date:
1990

Document version
Publisher's PDF, also known as Version of record

Citation for published version (APA):
Mwitwa, P. J. (1990). *Collecting Indigenous Forest Tree Seed in Zambia: Approach and Constraints*. Danida Forest Seed Centre. Technical Note no. 39



TECHNICAL NOTE NO.39 - APRIL 1990
Re-issued September 1994

COLLECTING INDIGENOUS FOREST TREE SEED IN ZAMBIA - APPROACH AND CONSTRAINTS

by
P.J. Mwitwa

DANIDA FOREST SEED CENTRE

Titel
Collecting indigenous forest tree seed in Zambia - approach and constraints

Author
P.J. Mwitwa

Publisher
Danida Forest Seed Centre

Series - title and no.
Technical Note no. 39

DTP
Melita Jørgensen

Citation
Mwitwa, P.J. 1990. Reissued 1994. Collecting indigenous forest tree seed in Zambia - approach and constraints. Technical Note no.39.

The report is available free of charge
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Electronic Version
www.SL.kvl.dk

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SUMMARY

The milieu in which indigenous tree species are found has a complex eco-biodiversity compared to the environment of exotic species, which are often planted in monoculture over large areas. Collection of seed from indigenous species needs a careful approach attained after detailed study of constraints brought about by their eco-biodiversity, careful preparation of the collection as well as adequate funding. It is not only the environment of the trees that affects collection, but also the inherent properties of the trees, availability of material and equipment together with trained and experienced personnel.

1. INTRODUCTION

Seed collection and handling are tasks which require the services of trained staff and a well-financed and well-equipped institution. If collecting for research in a well-funded organization, expenditure may be covered by special funds, whereas costs of commercial collections will have to be covered by part of the income from selling the seed. A combined operation, that is one where seed is collected for research as well as for commercial purposes, requires a staff well-versed in financial accounting in order to be able to keep cost of each operation separate. The proportion that goes to research must be calculated as a cost for the organization, otherwise this proportion may be underestimated.

The planning requires competent staff. The eco-biodiversity of the species necessitates sources of up to date information regarding species distribution and location as well as reliable information on flowering phenology.

The team that embarks on collection must have the tools for collection and storing and the market must be existing and well known. The selling price for a quantity of seed should reflect the costs of collection and handling as well as the dispatch or freight for the whole venture to be considered worthwhile.

2. IDENTIFYING SEED SOURCES

The identification of specific species lies solely with botanists or biologists and an updated species map of the country is an important asset to all involved parties. The species distribution list in Zambia has been drawn up but is outdated or has altered due to the lack of constant follow-ups with regard to population shifts, climatic and environmental changes.

Thus, a species known to exist in a certain area and to fruit in a certain month or months may either have been completely wiped out from an area, maybe in a virgin state or its fruiting circle may have altered considerably. Examples of such tree species include *Ricinodendron rautanenii*, which according to Fanshawe (1973) is shown to exist in the Copperbelt of Zambia but is in reality rarely found, also *Uapaca kirkiana* that may be flowering in the Copperbelt when in some parts of the Eastern Province it is already in fruit.

Even if it is indicated that a tree species exists in a given area, it would require preliminary reconnaissance by a taxonomist or botanist to verify its existence and location. The use of local people has some disad-

vantage as some have one name for more than one species. Where local people are used for identifying species, elderly people should be used because their knowledge of plants is much more reliable.

From a genetic point of view collection of quality material which represents a wide genetic pool may be quite questionable. This was the case in a seed collection programme where a *Pericorpsis angolensis* tree in heavy fruit was found to be very isolated with only one similar individual within a radius of 150-200 m. The question then arises as to the general combining ability of the genetic material; likewise in cases where no other trees of the same species is visible within a reasonable distance for pollination, identification and evaluation of the male parent tree becomes difficult. Furthermore, the material collected will in such cases usually consist of half sibs or full sibs (or may even originate from self-pollination) which will narrow the gene pool.

Therefore, only with miombos (*Brachystegia - Isoberlinia - Julbernadia* species) and some acacias one can expect that it will be easy to make quality selections of the sources of breeding material.

The collection of seed from indigenous tree species requires the services of a lot of professional and technical staff if information relating to maps showing species distribution and flowering phenology is not available.

3. FACTORS GOVERNING COLLECTION

Collection of seed from indigenous tree species is governed by several factors affecting or determining the methodology of collection. Apart from the species' biodiversity, these factors include terrain, vegetation, tree characteristics, type of fruit, equipment to use, training and number of persons involved. Each of these factors may adversely affect the quality and quantity of seed and the productivity of the seed collecting team.

3.1 Terrain conditions

For species located in mountainous or hilly terrain, problems of collecting from the ground after the fruit has been detached from the plant arise due to the slope. Therefore, seed and fruit may be found a considerable distance from the parent plant especially in areas without ground vegetation.

In mountain miombo type of vegetation, seed shed by the parent plant may get mixed up resulting in difficulties of pinpointing the species from which the seed has been shed. Species with seed similar in appearance include for example the *Brachystegia* species.

3.2 Ground vegetation

The type and amount of ground vegetation cover may either reduce output or facilitate conditions of increased output. Collecting seed and unopened pods of e.g. *Acacia gerrardii* and *Acacia polyacantha* is a very tedious task in an area with grass, as compared to areas where grass has been burnt.

This is also a problem in the collection of seeds from *Entada abyssinica* and some *Brachystegia* and *Julbernadia* species if collection of shed seed is required. Spreading hessian sacks or tarpaulins under *Acacia gerrardii*

and *A. polyacantha* trees lessens the work of picking one seed at a time because these species usually drop their seed when branches are shaken. This happens when the pods have dehisced.

3.3 Tree characteristics

Tree characteristics include diameter, height, branching habit, presence or absence of thorns, visible state of health, extent of fruiting, branch diameter and the distribution of fruits in the crown.

Seed collection made with proper seed collection equipment is not affected much by most tree species except in large diameter trees like *Adansonia digitata* where the chain of the portable ladders may not go round the tree trunk when there is a need to collect fruits still on the tree.

In some acacias where climbing is necessary, the height of the tree affects the area the dropped pods or seeds will cover especially when it is windy.

The diameter and number of branches also determine the speed of collection. Some trees with large branch diameters have fewer branches and collections from such trees takes quite some time involved in moving from one end of the crown to the other. Moving in a crown with thin branches may be dangerous.

Species with thorns and considerable height render difficulties to collecting teams. In Zambia mechanised seed collection is non-existent, so all collections are done manually. The seed collector is therefore left with no choice but to climb the tree and drop the fruits. In collecting from species like *Acacia polyacantha*, ladders may not be used to an advantageous bole height due to the branching habit. The whole aspect of collection therefore lies with the seed collector who should climb as carefully as he possibly can at his own discomfort. Thus, such characteristics greatly influence the production in seed collection.

Fruits found at the top of the crown make collection difficult as well as those found on the extremes of the crown as compared to fruits found within the crown. Collecting from *Brachystegia* and *Julbenadia spp*. is time consuming because most miombo species have the tendency of fruiting on the outside of the crown. Species such as *Terminalia sericea* are easy to collect from because the fruits are located all over the crown.

3.4 Type of fruit

The size of the fruits influences the method of collection and production. In miombo species, the pods are quite large and can easily be detached from the tree and picked from the ground. The number of seeds per fruit determines the output; for example, a *Ficus capensis* fig contains a lot of seeds compared to pods of acacias or a capsule of *Diospyros kirkii*.

Once dehiscent fruits are ready to dehisce, any shaking of the branches may result in the dehiscing of the pods which may drop down together with the seed.

In some cases, e.g. *Acacia polyacantha*, attack by biological agents results in difficulties in seed getting detached from the dehisced pods. This lowers production. The problem of insect attack is very prevalent in *Acacia spp.* Fruits of dehiscing species can be collected when they turn brown, e.g. *Brachystegia spp*., while some fruits can be collected while green when the seed has matured, in order to minimise the risk of beetle attack.

3.5 Equipment to use

The equipment and materials used in collecting fruits affect the ability of the seed collecting team greatly. Ladders currently under use should be modified to suit tropical indigenous forest tree conditions relating to tree size.

Wire hooks used in seed collection are not designed according to ergonomic specifications nor are there specific hooks for certain tree species. A hook suitable to use in collecting capsules from *Diospyros kirkii* and pods from *Brachystegia stipulata* must have a cutting edge and a suitable wooden handle.

Protective clothing in the form of heavy duty overalls, tree-climbing boots, gloves, helmets, protective eye glasses and a suitable safety belt are items that facilitate better working conditions.

These items are necessary especially in collecting fruits from *Diplorhynchus condylocarpon*. Helmets, eye glasses and gloves are necessary in thorny species like some acacias and species with large pods such as *Brachystegia* and *Julbernadia* species.

Protective clothing is not only necessary for the man climbing the trees but also for those collecting from the ground, especially in miombo species where a helmet is a safety necessity.

When handling pods which dehisce violently, such as *Brachystegia* species, gloves are necessary to avoid injuries.

3.6. Size and training of seed collection teams

Seed collecting in Zambia is done manually and is a labour intensive exercise. The team size should be combined with training where everyone in the team has a specific task to perform. It is advantageous and productive to have at least two experienced seed collectors in every seed collecting team, as collectors usually prefer to balance on tree branches when collecting seed from indigenous tree species, and this results in fatigue.

The fatigue increases with the number of trees climbed, and the number of trees climbed per day is affected by the extent of fruiting, type of fruit and the branching habit of the trees. Therefore climbers can be alternated periodically to spread the work load and increase the number of trees climbed. The equipment used in collecting seed from indigenous trees may have to be carried when the required seed sources are located far away from the road. Some members of the team may be used as carriers of equipment and collected fruit.

Training of the collectors is an absolute necessity, and all heads of sections or departments that have seed handling as part of their activities must have a working knowledge of seed collection and handling. This has been realised during collections where important factors related to collection and extraction came to light thanks to the expert information from experienced seed collectors.

4. PACKING AND TRANSPORTATION

The packing materials to be used for carrying fruits are determined by such characteristics as fruit size, quantity collected, and exudations, if any. Normally, exudations affect the handling of fruits of *Diplorhynchus condylocarpon* which become sticky after drying. Containers used for these fruits are usually not suitable for other species afterwards.

For fresh fruits, cardboard boxes can be used, depending on the quantity; hessian sacks are a possible alternative. Cardboard boxes are preferred to hessian sacks because fresh fruits may get mashed during handling before they reach the extraction point. This is likely to happen when large quantities are collected and when transport distances are long.

Whether mashed or not, the fruits are later removed from the sacks or cardboard boxes and either spread out to dry or soaked in water to facilitate extraction.

The type and size of the vehicle and accessibility to seed collection areas greatly influence the production of the seed collecting team. Where particular seed sources are located far away from the nearest roads, collecting large quantities is greatly hampered by the time required to locate the seed sources and the time required to carry the collected fruits to the vehicle as well as the number of people to carry these.

In sandy areas which are not densely wooded and where the terrain permits it, a vehicle with four-wheel drive may be used though this will increase the cost of fuel. The cost per kilo is reduced if large quantities of seed are collected within a short period and distance.

Where the seed store or laboratory is located far away from the collection zone, the vehicle to be used and the packing materials must offer an environment within which no harm will be done to the seeds/fruits.

As changes in conditions surrounding the collected materials may be harmful, transport time should be restricted to a minimum. This depends on the distance between the seed store and the collection site as well as the speed of the means of transportation.

5. SEED EXTRACTION

The methods of seed extraction in areas distant from proper seed storage facilities will depend on the type of fruit, the time to be spent by the seed-collecting team in the area, and availability of extraction equipment and man-power to execute the job. The types of fruit range from soft fleshy pulp to hard capsules, each category requiring a specific methodology of extraction.

For seed in soft fleshy pulp, manual mashing is employed after the fruits have been immersed in water for about twelve hours. The seed from such extraction is immediately spread out to dry on hessian sacks and not on cement floors nor on metal surfaces. This prevents a sudden build-up of heat that may be harmful to the freshly extracted seed. Normally, spreading of such seed on hessian sacks takes place when the intensity of the sun's heat is low, especially in late afternoon or the earlier part of the morning, so that drying takes place gently. Such species include e.g. *Diospyros kirkii* and *Flacourtia indica*.

Seeds contained in capsules like *Azanza gackeana* are extracted by cutting along sutures to remove the seed, which requires shorter drying period compared to seed from fleshy pulp. Dehiscent fruit can be collected while only partially dry before they dehisce and broadcast the seed.

Drying on metal surfaces, e. g. roofing sheets, speeds up the process of drying of the miombo species such as the *Brachystegia* and *Julbernadia spp*.

Fresh but mature pods of *Brachystegia stipulata* and other miombo species can be collected and sun dried until all pods have dehisced, the two valves either springing into spirals or completely coming apart throwing seed considerable distances away, up to a radius of approximately five metres around the drying area. Care must be taken to isolate different species with this characteristic by at least a distance of fifteen metres between drying areas. Such species include a lot of miombo species like *Brachystegia* and *Julbernadia spp*.

Indehiscent pods like pods of *Acacia albida* and the reluctantly dehiscent pods of *Acacia sieberana*, which are collected when dry, can be extracted by packing them into sacks and beating the sacks with wooden sticks. Then the seeds and the crushed material are winnowed using bamboo dishes. This is done in areas where machinery for processing such seeds does not exist.

Care should be taken to avoid nasal inhalation of *Acacia albida* dust as this leads to strong sneezing with consequential great inconvenience to people allergic to this dust.

Indehiscent pods collected fresh have to be sun dried. Seed collectors coming into contact with such species as *Cassia singueana* for the first time normally shake the dry pods to determine whether the seed inside the pod has dried. Once such pods are shaken and certified to have dried, they can be treated like dry indehiscent pods if the seed is not susceptible to damage. If susceptible, then the pods are attended to singly, by cutting them open e.g. the fruits of *Pterocarpus angolensis*.

Species with winged seeds are not treated in any special way except, when need be, chipping off a part of the wing to improve packing, e.g. seeds of *Diplorhynchus condylocarpon* and *Securidaca longipenduculata*.

Attention should be paid to the collection of winged seeds, which may be blown away after being released e.g. seeds of *Diplorhynchus condylocarpon*.

5.1 Storage

After cleaning, usually by removing chaff and bad seed, the seed can either be packed in plastic bags, cardboard boxes, hessian or sisal sacks. The container in which seed is stored is determined by the seed characteristics. Seeds which are not very dry should not be packed in plastic bags because they are likely to be attacked by fungi. Freshly extracted and less dry seed ferment; in particular this characteristic can be observed in seed of *Brachystegia* and some other miombo species. The reason is that partially dry pods contain seed which is not dry, as the pod dries faster than the seed. Therefore, after dehiscence the seed requires further drying otherwise, if packed in this state, it may be attacked by fungi. Seed of acacias, which in most cases is collected dry, can be packed in plastic bags or paper containers. It has been observed that the Bruchid family of insects that attacks some acacia seed before extraction does not attack extracted seed.

Seed with signs of fungal attack should not be packed together with unattacked seed, as the disease may spread when conditions become favourable. Problems encountered and solved in the collection area may

reduce problems of seed handling at the seed laboratory. These include early drying of the collected material, documentation, packing during transportation to the laboratory, and the quality of the seed delivered.

6. COST DETERMINANT FACTORS OF SEED COLLECTION

The costs incurred in collecting seed will be determined by the quantity to be collected, number of species to collect from, selection of trees with quality characteristics, equipment and material, labour force, distance to the collecting areas from the laboratory radius to be covered from the camping site, the time of the year, availability of documented information concerning species distribution, transport, and other factors that may crop up.

Quantity to be collected will determine the size of the labour force, equipment, material, and the type of transportation to use.

The number of species to collect from will determine the time to be spent in collecting, the equipment and material, fuel, and lubricants to be used.

The distance to be covered is a very important aspect in collecting indigenous tree seed. This factor may lead to the failure of the whole programme if it is not properly addressed. Since Zambia has a poor infrastructure, such as all-weather roads in some parts of the country, considerable distances may be covered on foot in marshland, mountains and inaccessible areas. Thus this will considerably affect the equipment and material that will have to be carried and consequently the quantity of collected material that the seed collecting team will be able to carry back.

Collection of seed from indigenous trees is an all-year-round task and therefore at one time or the other the collection programme will coincide with the rainy season. Climbing wet trees and picking seed in tropical rain storms is not a worthwhile exercise.

Labour force and transport take a large share of the expenses, and since the labour costs may be fixed per day, the total cost should be checked by elaborately planned collection programmes. Injuries, illnesses and vehicle breakdowns are problems that may have to be faced.

In the 1989 seed collection programmes for the seed laboratory based in Kitwe, about one hundred kilograms of seed were collected at a cost of K 560.00 per kg (equal to 30 dollars per kg).

7. CONSTRAINTS IN COLLECTION AND HANDLING

Problems include financial and technical aspects. Technical problems include identifying specific locations where required species could be found, area to be covered to reach the required seed sources, selection of mother trees and the state of their flowering, effect of human habitation, attack by biological agents, and the effect of fire, as well as problems in extraction and storage.

Identification of the specific area where a species could be found requires the expert knowledge of a taxonomist or botanist with prior information of the area.

The area covered in a day may not reflect actual amount collected, thus a lot of money could be spent in a day with little rewarding collections. Species that have been located may not have a bountiful fruiting that year, and the result of the collection may be very small. Depending on species distribution, certain areas may contain a lot of species which may reduce travel distance, or they may have only a few species which may force the seed collecting team to travel considerable distances.

As to tree improvement, the selection criteria for each species largely depend on the utilization aspect of each species; for example a fodder tree is required to be less tall than a timber tree, have a wider crown and denser foliage. A tree to yield timber or poles for construction may be subjected to criteria almost similar to those practised for plantation species. The criteria apply to neighbouring trees as well in order to be able to gauge the probable phenotype of the material to be collected.

Human habitation usually distorts information contained in documents which are not revised too often. Species found in an area in one year may be found to be absent or almost absent after some time if population shifts in the area are quite frequent.

The effect of climatic factors and attack by biological agents may make collections difficult. For instance, where acacias are attacked by insects, larger quantities of seed should be collected so that after sorting out the damaged seed, enough seed will remain to satisfy the requirements.

Constraints encountered in extraction and storage involves mostly material and labour which should be reconciled with the quantity. But the reconciliation can only be made when data on fruit collection per collector per day exist. In the absence of such information, experienced collectors may be used to make qualified guesses as to quantity that they can collect per day. Information from cone collections in exotics may be used with a suitable adjustment factor. In the absence of extraction machinery, extraction becomes a labour intensive exercise, and more damage will occur in extraction than in storage or during transportation. If more funds could be allocated to the skilled work of seed handling, it should be possible to increase the motivation of the labour force resulting in better seed handling.

8. CONCLUSION

The ability to collect sufficient amounts of quality seed of indigenous species is faced by a multitude of problems from the level of staff training to finance. Even if the seed store is able to collect sufficient high-quality seed, damages will still occur during storage. The damage is not a result of negligence of responsibilities but of limited equipment and storage facilities.

If the management objective is to make a profit, storage facilities must be adequate to safeguard the financial returns invested in the seed in storage, before any seed collection programmes are drawn up. Sufficient funding for all steps of seed collection is an absolute necessity otherwise the whole operation is doomed to failure right from the beginning.

Investment in training appropriate and competent staff must precede all programmes in seed collection, because the quality of the staff determines the quality of the whole seed collection and seed handling operation.

Apart from sufficient financial backing and training, market conditions must be known either through advertisement or research. The market must be both internal and external in which proper seed testing and storage techniques must conform with international regulations. Where necessary, destructive germination tests should be avoided by salvaging some seedlings for nursery transplants, which may later be sold or given to charity, if such a facility exists. In order to collect and sell seed economically, a background of economic planning with a profit motive must precede all programmes of seed collection and handling.

9. ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to the staff of the Seed Section for their assistance and to Mr. O. Shakachite and Mr. S. Chisumpa for their constructive criticism.

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